

Quick Reference

Note: Do not transmit HF during EE Labs

INSTRUCTION MANUAL

DRAKE

MODEL

L-4B



LINEAR AMPLIFIER

Price of Manual . . . \$2.00

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GENERAL SPECIFICATIONS

FREQUENCY COVERAGE - Ham bands 80 through 10 meters. All frequencies 3.5 to 30 MHz may be covered with some alteration of input circuit.

PLATE INPUT - 2000 watts PEP - SSB, 1000 watts DC on CW, AM and RTTY.

DRIVE REQUIREMENTS - 100 watts PEP - SSB, 75 watts CW, AM and RTTY.

INPUT IMPEDANCE - 50 ohms.

OUTPUT IMPEDANCE - Adjustable pi-network matches 50 ohm line with SWR not to exceed 2:1.

INTERMODULATION DISTORTION PRODUCTS - In excess of -33 DB

WATTMETER ACCURACY - 300 watts forward and reflected, \pm (5% of reading + 3 watts). 3000 watts forward, \pm (5% of reading + 30 watts).

POWER REQUIREMENTS - 230 volts 50 - 60 cycles 15 amperes, or 115 volts 50 - 60 cycles 30 amperes.

DIMENSIONS - Amplifier 13-15/16" W x 7-7/8" H x 14-5/16" D;
Power Supply 6-3/4" W x 7-7/8" H x 11" D.

WEIGHT - Amplifier 32 lbs; Power Supply 43 lbs.

TUBE COMPLEMENT - Two 3-500Z or Two 8802/3-500Z or Two 8163 or Two 3-400Z.

FRONT PANEL CONTROLS

ON-OFF - Rocker Switch

SSB-CW/TUNE - Rocker switch changes plate voltage for different modes of operation.

BAND - Switch selects desired ham bands (See Frequency Coverage).

PLATE and LOAD - Tuning adjust pi-network capacitors in tank circuit for proper resonance and loading on all bands.

METER - Switch selects monitoring either grid current, plate voltage, forward or reflected RF power on the lower meter.

AGC/STANDBY PUSH - Transmitting AGC threshold adjustment and push-pull switch that allows the L-4B to remain on while operating with the exciter only.

REAR JACKS - Power (connects L-4B to power supply), high voltage, VOX (for turn-on L-4B with exciter VOX contacts), transmitting AGC (for connecting transmitting AGC to exciter), RF input (for connecting to exciter RF output), RF output (connecting L-4B to an antenna).

GENERAL REQUIREMENTS

FREQUENCY COVERAGE - Band bands as shown in 2.2. All frequencies 2.2. to 10 MHz may be covered with some adjustment of input circuit.

PLATE INPUT - 2500 watts PEP - 1000 watts CW, AM and RTTY.

DC/AC REQUIREMENTS - 100 watts PEP - 100 watts CW, AM and RTTY.

INPUT IMPEDANCE - 50 ohms.

OUTPUT IMPEDANCE - Adjustable in discrete sections in the line with SWR not to exceed 2:1.

THE TRANSDUCER DISTORTION REQUIREMENTS - as shown in 2.3.1.2.

WAVEFORM ACCURACY - The output waveform shall be within 5% of the input waveform, 1000 watts forward, $\pm 10\%$ of output, 100 watts.

POWER REQUIREMENTS - 100 watts PEP - 100 watts CW, AM and RTTY. 100 watts PEP - 100 watts CW, AM and RTTY.

DIMENSIONS - As shown in 2.3.1.2.1. 100 watts PEP - 100 watts CW, AM and RTTY. 100 watts PEP - 100 watts CW, AM and RTTY.

WEIGHT - As shown in 2.3.1.2. 100 watts PEP - 100 watts CW, AM and RTTY. 100 watts PEP - 100 watts CW, AM and RTTY.

TEST COMPLIANCE - 100 watts PEP - 100 watts CW, AM and RTTY. 100 watts PEP - 100 watts CW, AM and RTTY.

TEST PANEL CONTROLS

ON-OFF - Switch or Button.

REL-CW/TUNE - Switch or Button. Switch or Button. Switch or Button.

SWR - Switch or Button. Switch or Button. Switch or Button.

1000 WATT LOAD - Switch or Button. Switch or Button. Switch or Button.

RELATIVE - Switch or Button. Switch or Button. Switch or Button.

RELATIVE - Switch or Button. Switch or Button. Switch or Button.

RELATIVE - Switch or Button. Switch or Button. Switch or Button.

RELATIVE - Switch or Button. Switch or Button. Switch or Button.

METERS - Plate Current, Grid Current/Plate Voltage/Forward Power/Reflected Power (switch selected).

POWER SUPPLY controls - Two circuit breaker reset buttons.

DESCRIPTION

The R L DRAKE Model L-4B Linear Amplifier offers continuous 2000 watts PEP-SSB, and 1000 watt DC. CW, AM and RTTY operation covering the ham bands 80 through 10 meters. All frequencies 3.5 to 30 MHz may be covered with some re-alteration of the input circuit.

The L-4B uses two 3-500Z or two 8802/3-500Z or two 8163 or two 3-400Z zero bias triodes in a Class B grounded grid circuit configuration that utilizes RF negative feedback for lower odd order distortion products.

A transmitting AGC circuit controls the exciter gain to allow the highest average power without peak clipping. An internal changeover relay feeds the antenna through when the L-4B is turned off. A pair of relay contacts bias the output tubes to cutoff, eliminating unwanted heat and diode noise when receiving.

The output tubes are forced-air cooled by a very quiet low velocity, high volume internal blower. Two taut-band suspension meters indicate plate current, grid current, plate voltage, and relative RF output power.

The separate solid state power supply requires no warm up period and provides excellent dynamic and static voltage regulation.

Do not turn on the L-4 amplifier with the top cover removed because the high voltage interlock shorts out the B+ and will damage power supply components.

INSTALLATION INSTRUCTIONS

The L-4B has been designed incorporating several inter-locks to prevent dangerous electrical shock. However, it is possible to disconnect the high voltage terminal while the L-4B is turned on. This is a potentially dangerous situation and should never be attempted for any reason. When disassembling the L-4B, the high voltage terminal should be disconnected last and upon reassembly the high voltage terminal should be connected first. The L-4B and its power supply can be installed and serviced in complete safety if the instructions in this manual are followed explicitly.

A. UNPACKING

Carefully remove your L-4B Amplifier, tubes and chimneys, and power supply from their packing cartons and examine them closely for signs of shipping damage. Should any damage be apparent, notify the delivering carrier immediately, stating the full extent of the damage.

Fill out and mail the enclosed registration card so that your warranty will be effective.

Save the packing material, you may need it later for reshipment or storage.

Inspect the packing material closely before putting it away to be sure you have not overlooked the cables or other hardware shipped with the L-4B.

B. TUBE AND CHIMNEY INSTALLATION

Tubes and chimneys can be installed after removing the top cover (see Service Data, Amplifier, Removing Top Cover).

The tubes are installed first. Notice that base Pin 3, the pin with no immediately adjacent pins, face in either socket, the ends of the amplifier case. When installing the tubes, push straight down to insert them and do not rock the tubes or the base pins may break.

The chimneys are installed after the tubes and extra care must be exercised while handling them because they are fragile. The chimneys should be installed by pushing two clips outward with the chimney until the opposite clips will be cleared when the chimney is lowered onto the chassis. Check to be sure that both chimneys are flush with the chassis and that no clips are inside of the chimneys. The parasitic chokes are installed after the tubes and chimneys. Remove the screw at the top of the plate connector and use this screw to fasten the parasitic choke to the plate connector. The parasitic choke coil should hang downward from the supporting leads. The free ends of both parasitic chokes can then be connected to the top of the plate RF choke with the 1/4 - 20 round head aluminum machine screw already in the top of the plate choke. Do not overtighten this screw when connecting the parasitic chokes; a snug fit is adequate. After replacing the top cover, the amplifier can be connected for operation.

C. LOCATION

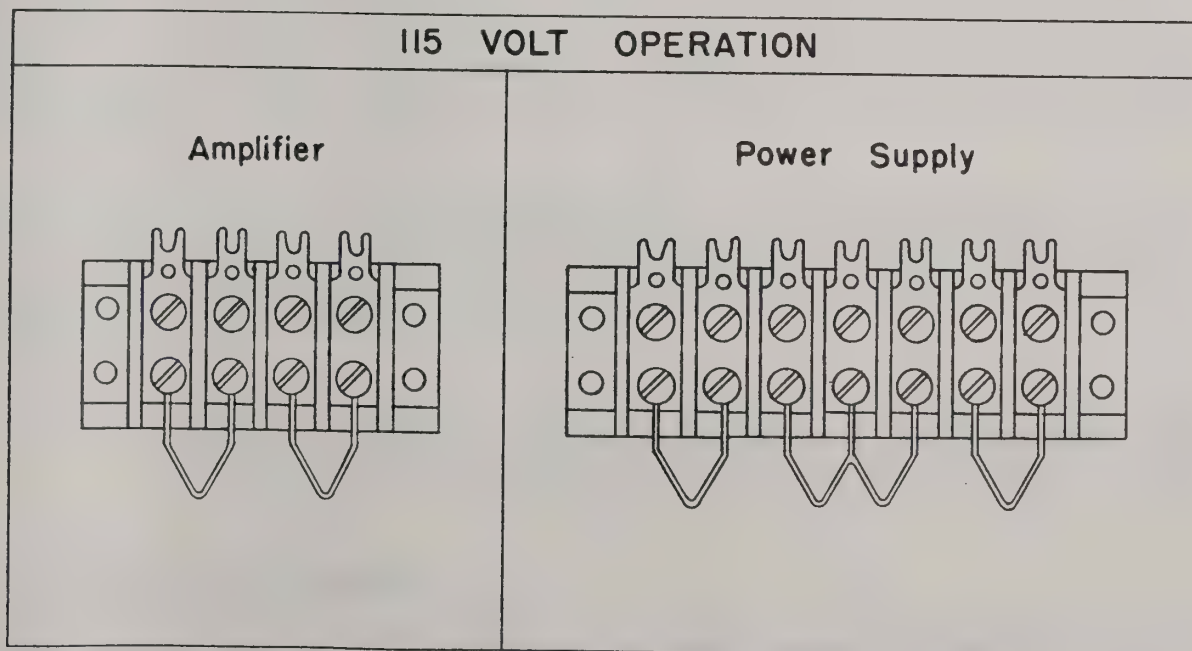
In general, the location of the L-4B is not critical, however, there are certain considerations which must be given to insure optimum performance. Care should be taken to insure that space is allowed around the amplifier and power supply cases to allow adequate air circulation. Extremely hot locations, such as near radiators or heating units should be avoided. Do not cover the tops of the amplifier or power supply cases with books, papers or other pieces or equipment or overheating may result. The back of the amplifier case must not be obstructed and should not be placed closer than 1 inch from a wall or the air inlet for the blower will be blocked and overheating of the amplifier tubes may occur.

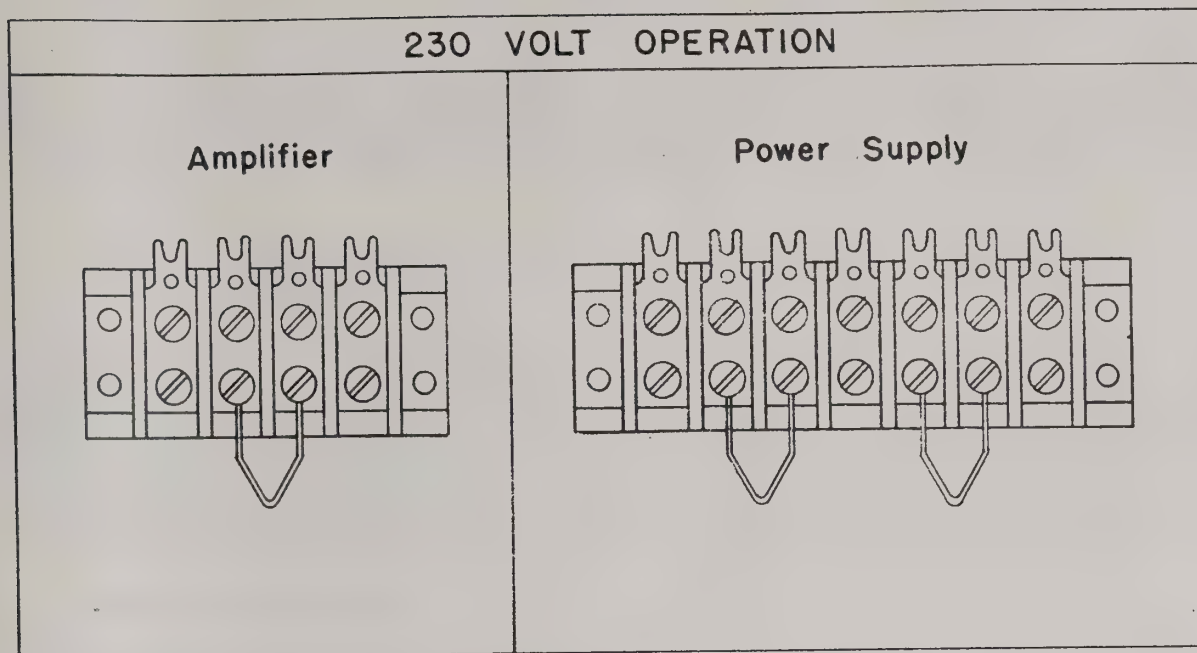
D. POWER REQUIREMENTS

The L-4B is included with its own separate power supply which can be operated from either 115 VAC or 230 VAC 50 - 60 cycles. Because of the large variety of plug and socket configurations for 230 volt service, and because the L-4B can be operated from either 115 volts or 230 volts, a line plug is not furnished with the L-4B. The L-4B is shipped from the factory with jumpers connected to operate on 230 VAC. It is highly recommended that the L-4B be operated from its own 230 volt 15 amp or greater, circuit. If a 115 V circuit is all that is available, it should be fused for 30 amps and the circuit conductors should not be less than #10 and no other equipment should be operated from this circuit. Do not under any circumstances operate the L-4B from a 115 volt lighting circuit because the circuit conductors are not large enough to safely carry this load.

E. JUMPER CONNECTION DIAGRAMS

Below are pictorials of jumper connections for both 230 V and 115 V operation. The jumpers in both the amplifier and power supply must be connected as shown or serious damage to the L-4B components may result.





F. LOW PASS FILTER

The L-4B has been designed in accordance with good engineering practices and second harmonic content is attenuated from the fundamental by at least 35 dB. Because of the possibility that you may be using a multiband antenna or have a feed line that is resonant at a harmonic frequency, it is highly recommended that a suitable low pass filter such as our Model TV-1000-LP be used with the L-4B.

G. ANTENNA REQUIREMENTS

The L-4B has been designed for use with antennas resonant at the operating frequency and having approximate impedances within the limits of 25 to 100 ohms. The nominal output impedance of the L-4B is 50 ohms and the SWR of this load should never exceed 2:1. Although there are many types of antennas which will meet these requirements, the simplest is a one-half ($1/2$) wave dipole center fed with 52 ohm coax. For a detailed discussion on antennas, we suggest referring to an appropriate antenna book.

Most practical antennas exhibit an SWR range over a complete amateur band that exceeds 2:1. For this reason we recommend using an antenna matching network such as our MN-2000 which will allow the L-4B to work into a 50 ohm load for maximum power transfer into the antenna.

CAUTION: NEVER ATTEMPT TO OPERATE THE L-4B WITHOUT FIRST CONNECTING IT TO AN ANTENNA OR 50 OHM DUMMY LOAD OF SUFFICIENT POWER HANDLING CAPACITY OR SERIOUS DAMAGE MAY RESULT.

H. GROUND REQUIREMENTS

The L-4B should be attached to a good earth ground through as short and as large a ground strap as possible for best results. A binding post is provided on the

rear of the L-4B chassis for this purpose.

It is always a good idea to connect the chassis' of all associated equipment together and ground them at one point to avoid ground loops. We recommend that all of the equipment in your station be connected together and grounded at the L-4B amplifier chassis.

I. EXCITER REQUIREMENTS

To operate the L-4B at the maximum legal input, it will be required of the exciter to deliver to the L-4B input connector, 100 watts PEP-SSB RF power and 75 watts RF power on CW, AM RTTY and TUNE. The TR-3, TR-4, T-4/T-4X/T-4XB Transmitters all have adequate power to drive the L-4B to the maximum legal input allowed on SSB, CW, RTTY and AM. The exciter should be placed as close to the L-4B amplifier as practical so that the coax and ground strap will be short.

J. TRANSMITTING AGC

A jack on the rear of the L-4B amplifier is provided for connection to the exciter of a transmitting AGC voltage which controls the gain of the exciter so that any power level can be run up to 2000 watts PEP without peak clipping. The L-4B is supplied with a cable to connect this jack to a similar jack on our Model AC-4 Power Supply which terminates in the particular transmitter the AC-4 is powering.

A connector is available for AC-3 Power Supplies that brings out the vox contacts and a transmitting AGC connector from the transmitter that the AC-3 is powering.

K. VOX RELAY

A two pin jack on the rear of the L-4B amplifier is provided for connection to a pair of normally open relay contacts in the exciter which close on transmit and thus turn on the L-4B at the same time. The L-4B is supplied with a cable to connect this jack to a similar jack on our Model AC-4 Power Supply which terminates in the particular transmitter the AC-4 is powering.

Some exciters (except TR-3, TR-4, T-4/T-4X/T-4XB) ground one of the extra relay contacts made available to key a linear amplifier. For these exciters it will be necessary to plug the two pin connector into the L-4B vox socket in the correct position. With the exciter in standby, if plugging in the vox connector causes the L-4B plate current to read up scale, reverse the vox connector in its socket so that the L-4B plate current is zero.

L INITIAL CONNECTION DIAGRAMS

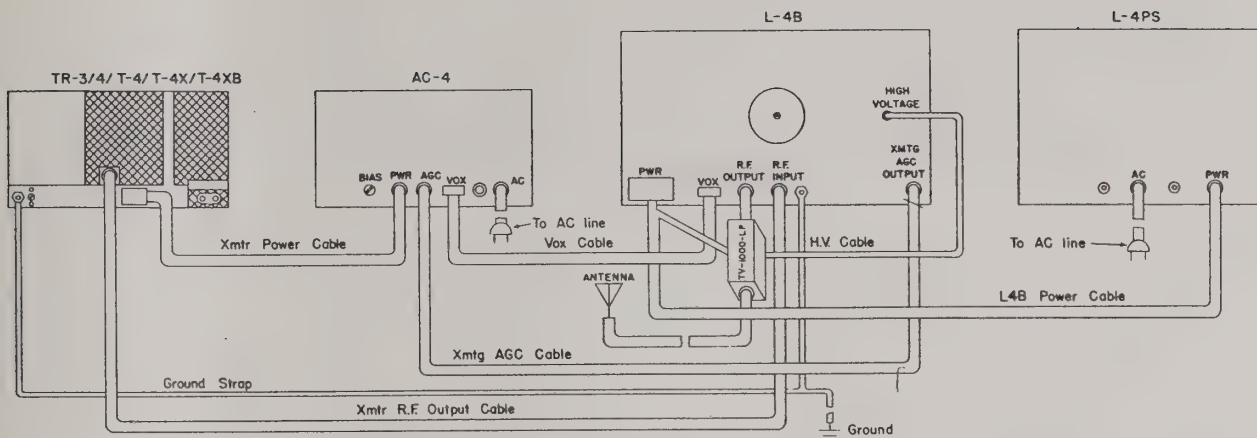


FIG 1 CONNECTING THE TR-3/TR-4/T-4/T-4X AND AC-4 TO THE L4B LINEAR AMPLIFIER

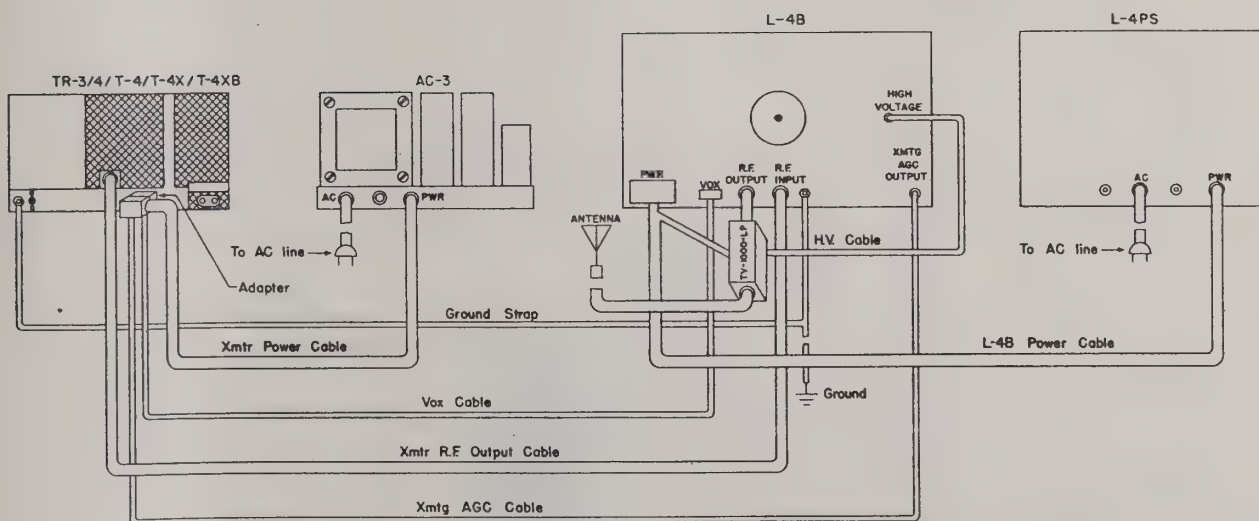
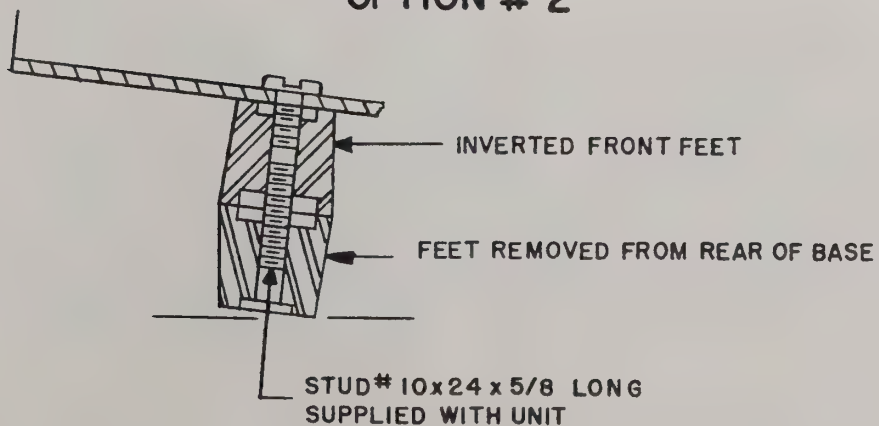
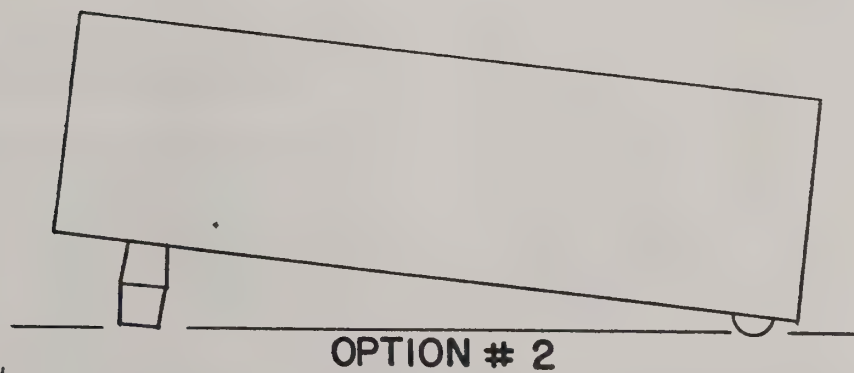
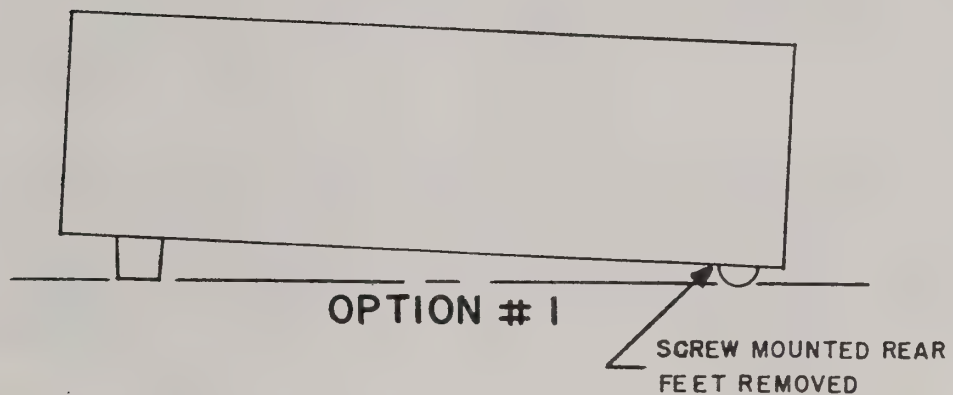
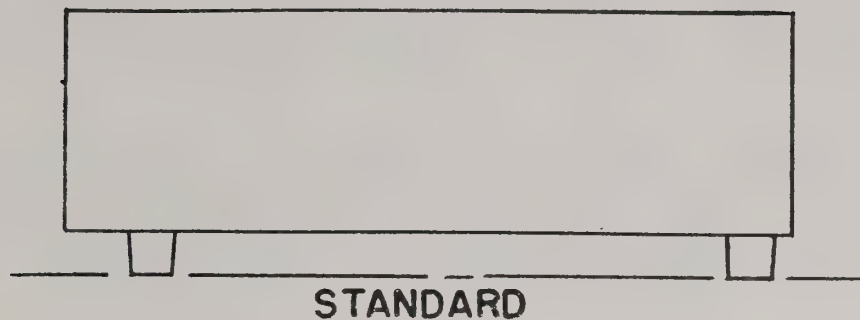


FIG 2 CONNECTING THE TR-4/TR-3/T-4/T-4X AND AC-3 TO THE L4B LINEAR AMPLIFIER

M. VIEWING ANGLE OPTIONS



TUNING PROCEDURE

WARNING - Be sure that the L-4B is connected to a 50 ohm antenna or 50 ohm dummy load and that the proper jumpers have been installed in BOTH the power supply and linear amplifier for the line voltage that is to be used. (See 115 V and 230 V Jumper Connections, Page 4 and 5).

For all modes of operation, the L-4B is tuned up with a single RF frequency driving it and with the plate voltage switch in CW-TUNE position. The exciter may be tuned up on CW into the antenna connected to the L-4B by pushing the AGC/STANDBY push switch in. The exciter should be checked to be sure that it is tuned up when driving the L-4B since the antenna connected to the L-4B may not be 50 ohms.

After the exciter has been tuned up, turn the exciter to standby and pull the AGC/STANDBY push switch out on the L-4B and put the plate voltage switch (red rocker switch) to CW-TUNE position. The red light that indicates high plate voltage for SSB operation should be off.

Some exciters utilize transmitting AGC, sometimes called ALC, during all modes of operation. During tune up, transmitting AGC will have to be defeated by either unplugging the transmitting AGC connector, or turning the AGC/STANDBY push control fully counter-clockwise. The TR-3, TR-4, T-4/T-4X/T-4XB Transmitters switch off AGC in TUNE, CW, and AM modes; it is unnecessary to externally defeat AGC on these transmitters.

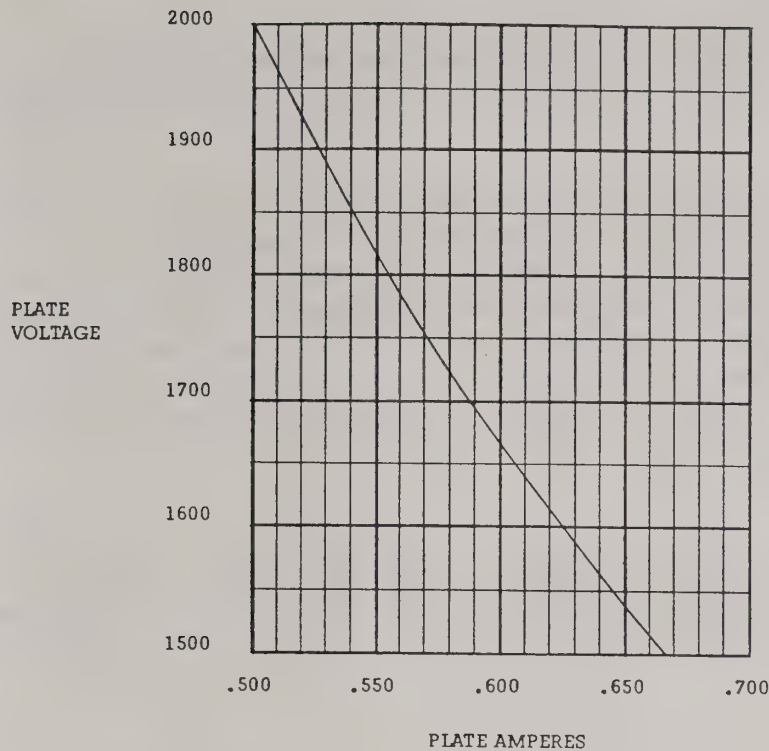
A. CW, RTTY

PRESET THE CONTROLS AS FOLLOWS:

1. Plate voltage switch in CW-TUNE.
2. Band switch to desired band.
3. Meter switch to 3000 watts forward.
4. Load fully counter-clockwise (CCW) on the number zero.
5. Plate control in the arc provided for the desired band.
6. Turn AGC/STANDBY push control fully counter-clockwise (CCW).

Turn on the exciter and increase the exciter output while not exceeding .4 plate amps and tune the plate control for a dip in plate current. Alternately adjust the load and plate controls while increasing the exciter power in small increments until maximum RF output occurs at .565 plate amps. Because of variations in line voltage a graph is supplied below which correlates plate voltage and plate current for 1000 watts DC plate input power and should be used to be sure that the L-4B is operating at or under the maximum legal input power. In case maximum legal input cannot be obtained because of low exciter power, tune the L-4B for maximum forward RF watts at maximum exciter power.

1000 Watts D.C. Input
VS
Plate Voltage and Plate Amperes



B. SSB, AM

PRESET THE CONTROLS AS FOLLOWS:

1. Plate voltage switch in CW-TUNE position.
2. Band switch to desired band.
3. Meter switch to grid current.
4. Load fully counter-clockwise (CCW) on the number zero.
5. Plate control in the arc provided for the desired band.
6. Turn AGC/STANDBY push control fully counter-clockwise (CCW).
7. Substitute 250 ma grid current in succeeding text if Amperex 8802/3-500Z tubes have been supplied.

Turn on the exciter and increase the exciter output while not exceeding .4 plate amps and tune the plate control for a dip in plate current. While increasing the exciter power, maintain 220 ma of grid current with the load control until .565 plate amps is reached. Leave the exciter power at this level and re-dip the plate current with the plate control and then bring the grid current back to 220 ma with the load control. The L-4B will now be very close to being tuned up and only small adjustments of the driving power, and plate and load controls will be necessary to obtain .565 plate amps with 220 ma grid current at resonance.

The forward power meter is a more sensitive indication of plate tank resonance than plate current dip, and the plate control should be adjusted for maximum forward power while still maintaining the relationship of .565 plate amps to 220 ma grid current. In case .565 plate amps cannot be reached because of low exciter power, tune the L-4B for maximum forward RF watts at maximum exciter power.

OPERATION

In the following information concerning operation on various modes, it is assumed that the L-4B and its exciter have been tuned up on the desired operating frequency as described in the Tuning Procedure.

While transmitting with the L-4B over extended periods of time, the final amplifier plates may show a dull red color. This is normal and does not detract from the life of the tubes. If the plates display a very bright orange color it is advised that the L-4B be checked to determine that it is not being over-driven and that it is tuned up properly. The L-4B should not be turned off immediately after long periods of transmitting, but should be left on standby with zero plate amps for several minutes to allow the final amplifier tubes to cool down.

A. CW, RTTY

For CW and RTTY operation the plate voltage switch should be in CW-TUNE position. With the exciter on and the key depressed, adjust the drive level until the product of plate voltage and plate current is at or under maximum legal input power.

B. SSB

For SSB operation the plate voltage switch should be in SSB position and the red light that indicates high plate voltage should be on. The transmitting AGC threshold must be set before using the L-4B.

With the plate voltage switch in CW-TUNE position the transmitting AGC threshold is adjusted by applying a large single audio tone into the microphone input of the exciter by either an oscillator or by whistling a single tone into the microphone with the exciter adjusted for maximum output. With this single tone applied, turn the AGC/STANDBY push control clockwise until the plate current is .580 amps. If you desire to run less than 2 kilowatts PEP, turn the AGC/STANDBY push control clockwise until the single tone plate current decreases to the power level you desire. Return the plate voltage switch to SSB. The AGC threshold needs only to be set once on each band. When making large changes in frequency within a band, the L-4B should be checked for plate tank resonance while still maintaining the relationship of .565 plate amps to 220 ma grid current on CW-TUNE. Under normal voice operating conditions, the exciter should be adjusted to run the L-4B plate meter between .300 to .400 amps. .400 amps of plate current is the maximum legal input allowed and this level should be reached only occasionally and never exceeded.

If the exciter has no provisions for transmitting AGC, the output from the L-4B should be monitored with an oscilloscope to check for peak clipping.

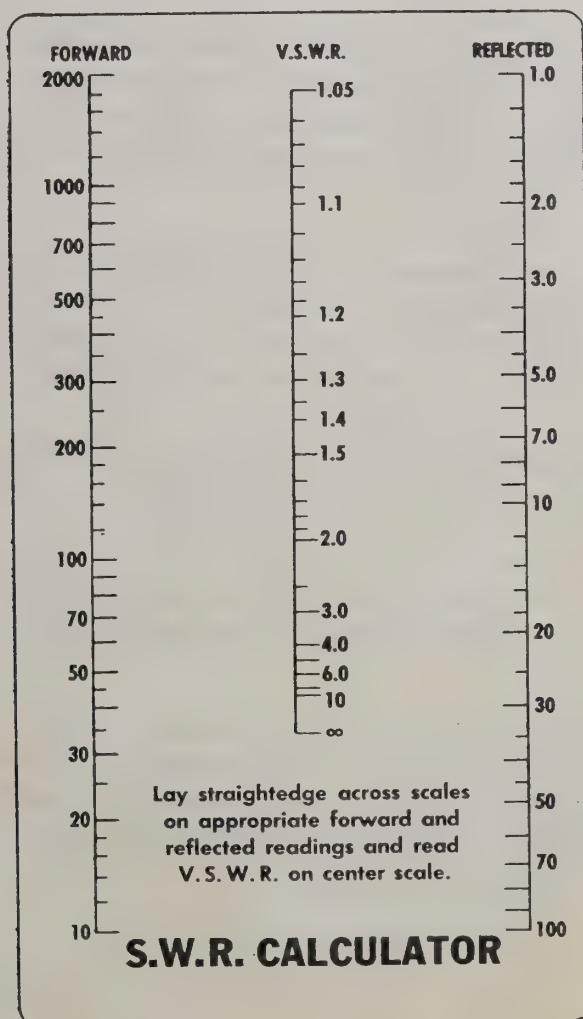
C. AM

For AM operation the plate voltage switch should be in SSB position and the red light that indicates high plate voltage should be on. The L-4B works quite favor-

ably with the TR-3, TR-4, T-4/T-4X/T-4XB on AM since these transmitters use controlled carrier modulation. Transmitting AGC is not used on AM with the TR-3, TR-4, T-4/T-4X/T-4XB Transmitters and the L-4B output should be monitored with an oscilloscope to check for peak clipping. If the L-4B is to be used with a 100 % modulated AM transmitter, the exciter should be adjusted to run the L-4B at 500 watts DC input with an unmodulated carrier.

D. SWR CALCULATION

The SWR of the load connected to the L-4B can be determined by using the forward and reflected power readings from the L-4B wattmeter and the SWR calculator supplied with the L-4B. The calculator is used by laying a straight-edge across the scales at the L-4B forward and reflected meter readings and reading the VSWR on the center scale at the intersection of the straight line. The L-4B wattmeter indicates forward and reflected power at all times, so that SWR can be calculated using only the exciter. For measuring the exciter R.F. output power a higher degree of accuracy can be obtained by using the 300 watt forward scale instead of the 3000 watt scale. When returning the L-4B into service, be sure to return the meter to 3000 watts or the wattmeter may be damaged. The amount of RF power delivered to the load can be determined by subtracting the reflected power from the forward power.



E. OPERATION ON ACCESSORY FREQUENCIES

Bandswitch Position	Frequency in MHz
80	3.2 - 5.0
40	5.0 - 10.5
20	10.5 - 15.5
15	15.5 - 22
10	22 - 30

The input coils may be re-tuned for frequencies moderately removed from the amateur bands. For frequencies far removed, it may be necessary to change the values of the capacitors in the input circuit.

THEORY OF OPERATION

The 50 ohm input is matched to the final amplifier cathodes by a pi-network on each band which is selected by the input switch S1a, S1b. The input switch is ganged to the bandswitch S2. Negative feedback in the L-4B amplifier is obtained by slightly raising the grids above ground with capacitors C23, C29, C30, C31, C32 and C37.

When the negative going peak RF voltage from the capacitor divider C24, C25 exceeds the positive bias set by R3, the transmitting AGC threshold control, D1 conducts and a negative voltage proportional to the RF signal applied to the input appears at the transmitting AGC output connector.

A positive voltage from the resistor divider, R9, R10, R11 in the power supply is applied to the cathode during standby which cuts off the plate current.

The plate circuit is matched to the 50 ohm output by the adjustable pi-network consisting of C46, L6, L7, C48, C49, C52, C53 and C56.

The directional wattmeter consists basically of L8, C54, C55 and C57, which take the sum and difference of the transmission line phase voltages and currents to indicate forward and reflected RF power. D3, D4, C59, C60, R15, R17, R18, and R19 rectify, filter, and multiply the lower front panel meter M2's basic 200 ma movement to indicate forward and reflected RF power.

SERVICE DATA

WARNING - EXTREME CAUTION SHOULD BE EXERCISED WHENEVER MAKING ANY ADJUSTMENTS INSIDE EITHER THE AMPLIFIER OR POWER SUPPLY. BEFORE MAKING ANY ADJUSTMENTS TO THE L-4B UNPLUG THE POWER SUPPLY FROM THE POWER LINE, UNPLUG THE POWER CONNECTOR GOING FROM THE POWER SUPPLY TO THE L-4B, AND LAST; DISCONNECT THE HIGH VOLTAGE TERMINAL FROM THE AMPLIFIER.

A. AMPLIFIER

1. Removing top cover -

After completely disconnecting the L-4B from all sources of power, the top cover can then be safely removed by taking out the top row of three screws on both sides of the amplifier.

2. Removing bottom cover -

After completely disconnecting the L-4B from all sources of power, the bottom cover can then be safely removed by taking out the bottom row of three screws on both sides of the amplifier.

3. Removing front panel -

The front panel can be removed only after first removing the top and bottom of the amplifier. The knobs should be removed next followed by removal of the six screws that hold the front panel to the chassis. Finally, unsolder the leads of the front panel indicator lights from their terminal strip. Be careful to note the terminals that each lamp was connected to so replacement will be made easier.

4. Cleaning amplifier compartment -

Since the amplifier compartment is forced-air cooled, it will collect particles of dust which must be removed periodically. The frequency of cleaning will be governed by how many hours the L-4B is operated, and by how clean its environment is. When the blower wheel accumulates a large amount of dust, the amplifier should be cleaned. The best way to clean the amplifier is to remove the top and bottom covers and blow the dust out with compressed air. If compressed air is not available, a soft bristled 1 inch paint brush can be used to brush the amplifier clean.

5. Tube replacement -

If it becomes necessary to replace the tubes in the L-4B, the same brand should be used or it may be necessary to tune the input coils (See Input Coil Adjustment, Page 18). If one tube needs replacement, it should be replaced by the same brand of tube as originally supplied.

6. Input Switch Drive Belt Replacement -

The input switch is linked to the bandswitch by two pulleys and a bead belt. If the belt ever needs replacement, it should be done in the following manner.

6. Input Switch Drive Belt Replacement (Continued)

Set the bandswitch to 20 meters and remove the top and bottom covers of the amplifier and remove the front panel. Loosen the setscrews in the pulley that is on the bandswitch shaft and remove the pulley. Hold the input switch shaft and remove only the pulley on this shaft. If the input switch shaft has been removed, great caution in replacing this shaft must be taken to insure that the input switch rotors are aligned and are not damaged by the shaft insertion forces. Set the input switch on 20 meters and with the new belt connecting both pulleys, install the pulleys on their respective shafts at the same time. The copper sleeve on the chain should be midway between the two switch shafts. Before tightening the setscrews on the bandswitch pulley, check that the input switch is still aligned for 20 meters. Tighten the set screws, replace the front panel and amplifier covers.

7. Lubrication of blower motor -

The blower motor should be lubricated once a year with several drops of 10 weight petroleum oil in the front and rear bearing oiler tubes.

8. Troubleshooting -

Careful consideration has been given to the design of the L-4B to keep maintenance problems to a minimum. However, it is quite possible that some problem will arise which cannot be cured by tube substitution. If this occurs, we suggest that you either return your unit to your dealer, or write direct to our CUSTOMER SERVICE DEPARTMENT describing your problem in detail. Include full information concerning external connections, control settings, associated equipment, antenna and be sure to indicate the serial number of the L-4B.

DO NOT RETURN EQUIPMENT TO THE FACTORY WITHOUT PRIOR AUTHORIZATION.

L-4B PLATE VOLTAGE

CW - Tune	1900 volts	No Load	1760 volts	@	.565 amps
SSB	2600 volts	No Load	2400 volts	@	.800 amps

L-4B IDLING PLATE CURRENT

	CW-Tune	SSB
Amperex 8802/3-500Z	.100 amps	.160 amps
Amperex 8163 tubes	.100 amps	.160 amps
Eimac 3-400Z tubes	.110 amps	.170 amps
Eimac 3-500Z tubes	.170 amps	.260 amps

All tubes above are directly interchangeable in the L-4B and are capable of operating the full legal limit for amateur service.

All voltages and currents listed above bear a 10% tolerance for tube and line voltage variations.

B. POWER SUPPLY

1. Circuit breaker reset -

There are two buttons on the power supply which are provided for resetting the circuit breakers in case they should trip from overloading. If the circuit breakers trip, turn off the L-4B and wait for one minute before resetting. If the circuit breakers trip immediately after resetting and turning the L-4B on, an investigation should be made to determine the cause of the overload.

2. Removing bottom cover -

After completely disconnecting all sources of power, the bottom cover of the power supply can be removed by taking out all of the screws around the bottom of the power supply chassis.

3. Removing top cover -

The top cover cannot be removed until the bottom cover has first been removed. After the bottom has been removed, remove the line cord wires from the barrier strip and ground. The top can then be removed by taking out the remaining screws holding the top cover to the chassis.

4. Troubleshooting -

Careful consideration has been given to the design of the L-4B Power Supply to keep maintenance problems to a minimum. However, if the power supply fails to function, first check the circuit breakers and reset them if it is necessary. If the circuit breakers continually trip, check for short circuits in the high voltage line. Especially be certain that the high voltage interlock in the amplifier is not shorting the high voltage to ground as it is supposed to do when the top cover is taken off the amplifier. If the circuit breakers have been tripped because of a short in the high voltage line, a continuity check should be given to each silicon diode bank to determine if either or both banks have failed. In the event of a short circuit, resistor R12 in the power supply will be destroyed. This resistor protects the diodes in the power supply and it should be replaced with an IRC .82 ohm 2 watt type BWH resistor ONLY. In the event of difficulty, we recommend that you return your unit to your dealer, or write direct to our CUSTOMER SERVICE DEPARTMENT describing your problem in detail. Include full information concerning the circumstances during the failure, any measurements that were made and also be sure to note the serial number.

DO NOT RETURN EQUIPMENT TO THE FACTORY WITHOUT PRIOR AUTHORIZATION.

C. ORDERING REPLACEMENT SERVICE PARTS

When ordering replacement parts, identify whether the part is for the power supply or amplifier, state the serial number of the power supply or amplifier, give the schematic part number, and briefly describe the part.

D. RETURNING THE L-4B TO THE FACTORY FOR SERVICE

Obtain a return authorization form from the Customer Service Department. Follow the instructions of the return authorization form. DO NOT ship the L-4B with the tubes and chimneys installed! If the tubes are in question, return the tubes in the original or in new cartons obtained from the R.L. Drake Company. The R.L. Drake Company will assume no responsibility if the transportation company refuses to pay a damage claim due to improper packing or lack of insurance.

ALIGNMENT

A. INPUT COIL ADJUSTMENT

If the final amplifier tubes are replaced with a brand other than originally supplied, the input coils may have to be retuned. The input coils can be retuned if it is desired to operate the L-4B outside of the amateur bands.

Input coil adjustment is done with a 50 ohm SWR bridge inserted between the exciter output and the L-4B's RF input coax jack.

To tune the input coils, first disconnect the L-4B Power Supply from the power line, remove the bottom cover of the power supply (See Page 15) and remove the jumpers from the 7 terminal barrier strip (See Page 4 and 5). Removing these jumpers allows the filaments, relay power, and the blower to operate without the high voltage on. After removing the jumpers in the power supply, remove the top cover of the amplifier and DO NOT defeat the high voltage interlock. The amplifier should be connected to the exciter as for normal operation (See Page 7) with the exception of the SWR bridge in the input line. Preset the controls as follows:

1. Bandswitch on desired band to be tuned.
2. Load fully counter-clockwise (CCW) on the number zero.
3. Plate control in the arc provided for the desired band.
4. AGC/STANDBY push control pulled out.

With the exciter tuned up on CW in the middle of the band to be tuned, turn on the L-4B and increase the output from the exciter until the plate meter reads .4 amps. Tune the plate control for a dip in plate current and turn the slug on the correct input coil for a minimum reflected power reading on the SWR bridge that is connected between the exciter output and the L-4B's RF input. The input coils are adjusted at the factory for the center of each band and are broad enough to cover the entire band. When the coils are tuned on the amateur bands the slugs are close to the top of their travel.

B. METER ADJUSTMENT

The two meters on the front panel can be set to zero if it should become necessary by removing the top and bottom covers, knobs, and front panel on the amplifier (See Service Data, Page 14). The meters are set to zero by a conventional zero-setting screw adjustment on the lower face of the meter. The shunt for the grid current meter is adjusted in production and should normally never need calibration. If the lower meter or R8 is ever replaced, the grid current shunt will have to be calibrated. This can be done by completely disconnecting the amplifier and removing the top cover. Defeat the high voltage interlock by setting a book on top of the operating rod only after all connectors have been removed from the amplifier. Place the meter switch in grid current position. The grid current meter can be calibrated against a standard meter in series with a 1-1/2 volt battery in series with a 10 ohm potentiometer. The negative battery terminal connects to the L-4B chassis and the positive lead should be connected at the junction of R8, R11, R16 and C40. When the standard meter reads .400 amps, adjust R16 until the grid

current meter reads 400 ma. If no standard meter is available, reverse the wires going to the plate meter terminals and connect the positive terminal of a 1-1/2 volt battery in series with a 10 ohm potentiometer to Pin 6 of the power connector on the rear of the amplifier. Connect the negative lead to ground. Adjust the 10 ohm potentiometer until the plate meter reads .400 amps and then make the grid current meter agree at 400 ma by rotating R16. Replace the wires on the plate meter to their original posts and replace the top cover on the amplifier.

C. KNOB POINTER ALIGNMENT

When replacing the knobs on the L-4B amplifier, correct alignment of the plate and load controls is important. All of the other controls have flats on the control shafts and the setscrews in the knobs should press against the flat.

The load control shaft should be rotated fully counter-clockwise (CCW) and the knob pointer resting on the number zero before the setscrew is tightened. The plate control shaft should be rotated so that the plates of C46 are fully meshed and the pointer should be resting in a nine o'clock position at the end of the tuning arc. The plate control knob is set by tuning up the L-4B on 21.225 MHz 1000 watts CW. After tune-up hold the plate tuning knob with one hand and push the indicator to the 15 meter segment of the tuning arc with your other hand.

D. WATTMETER CALIBRATION

The wattmeter in the L-4B was designed to keep maintenance to a minimum. The wattmeter is a passive device and it should provide years of service and maintain its calibration. If it becomes necessary to calibrate the wattmeter, the following equipment will be necessary.

1. A 50 ohm dummy load with an SWR of no more than 1.05:1 through 30 MHz and capable of handling 1 kw.
2. An accurate RF wattmeter or even better, an accurate RF voltmeter such as a Hewlett Packard 410B or a Boonton 91CA.
3. A transmitter with variable output to 1 kw CW at 14 MHz.
4. One insulated alignment tool.

The following instructions must be followed in sequence for correct calibration.

Null Adjustment: With the L-4B completely disconnected, turn it upside-down and remove the L-4B bottom cover. Connect the exciter to the RF input and the 50 ohm load to the RF output. Set the L-4B meter switch on 300 WATTS REF. Apply between 100 and 300 watts of power at 14 MHz and with the insulated alignment tool adjust the piston trimmer on the wattmeter board located in the middle rear bottom of the L-4B for a minimum indication of reflected power. All further adjustments should be made with the L-4B in its normal upright level position.

300 Watts Forward: With the L-4B connected as in the null adjustment, place the meter switch on 300 WATTS FORWARD and apply 300 watts from the exciter. If 300 watts is not available, adjust the exciter for maximum RF output. Locate the calibrating potentiometer for this range which is located on the wattmeter printed circuit board and closest to the bottom cover. This potentiometer should be adjusted so that the L-4B wattmeter agrees with the standard wattmeter or with the RF power calculated from the RF voltage measurement.

3000 Watts Forward: After the 300 watts forward calibration, place the meter switch in the 3000 WATTS FORWARD position and apply 1000 watts from the exciter. If 1000 watts is not available, adjust the exciter for maximum RF output. Locate the calibrating potentiometer for this range which is the middle potentiometer on the wattmeter printed circuit board. This potentiometer should be adjusted so that the L-4B wattmeter agrees with the standard wattmeter or with the RF power calculated from the RF voltage measurement.

300 Watts Reflected: Connect the exciter to the RF OUTPUT and the 50 ohm load to the RF INPUT. Set the meter switch to 300 WATTS REFLECTED and apply 300 watts from the exciter. If 300 watts is not available, adjust the exciter for maximum RF output. Locate the calibrating potentiometer for this range which is the potentiometer located closest to the chassis on the wattmeter printed circuit board. This potentiometer should be adjusted so that the L-4B wattmeter agrees with the standard wattmeter or with the RF power calculated from the RF voltage measurement.

WARNING:

BE SURE THAT YOU CAN READ THE WORD " T O P " PRINTED ON THE INSTALLED
PARASITIC CHOKES WHEN LOOKING DOWN INTO THE TOP OF THE AMPLIFIER.
FAILURE TO INSTALL THE PARASITIC CHOKES PROPERLY MAY RESULT IN A HIGH
VOLTAGE SHORT CIRCUIT AND DAMAGED POWER SUPPLY COMPONENTS .

R. L. Drake Company
Miamisburg ,Ohio 45342

L-4B LINEAR AMPLIFIER SPARE PARTS LIST

February 1, 1971

Prices subject to change
without notice

<u>QTY</u>	<u>SYMBOL</u>	<u>USED*</u> <u>ON</u>	<u>ITEM</u>	<u>PRICE</u> <u>EACH</u>
2	---	PS	Board, Power Supply complete with diodes, elect. capacitors & resistors	\$34.00
1	---	PS	Cable, power supply, multi-conductor, complete with connector	8.50
1	---	-	Cable, Vox relay connector, 6 ft.	1.50
1	---	-	Cable, with connectors, AGC	1.50
1	L6	A	Coil, tank, (silver plated)	9.00
1	L7	A	Coil, tank, (on ceramic form)	9.00
1	---	A	Cabinet, amplifier top & bottom with feet	18.00
1	---	PS	Cover, power supply top	6.00
1	---	PS	Cover, power supply bottom	3.00
8	C thru 10	PS	Capacitor, elect., 200 ufd @ 450 V	5.25
1	C43,49,52, 53	A	Capacitor, variable, 4 sect. Ant. Load	28.00
1	C46	A	Capacitor, variable, plate tune	20.00
6	C23,29,30 31,32,37	A	Capacitor, disc, grid by-pass	.15
1	---	PS	Carton, shipping	2.00
1	---	-	Carton, shipping, tubes & chimneys	1.00
1	---	A	Carton, shipping	3.00
2	---	A	Chimney, amplifier tube	3.20
2	RFC 1,3	A	Choke, grid	.60
2	PC 1,2	A	Choke, plate, parasitic, with resistors	1.25
1	RFC 4	A	Choke, plate, RF	7.50
1	RFC 2	A	Choke, filament	3.50
2	---	PS	Circuit breaker, 15 amp.	1.65
1	P1	PS	Connector, 3 pin, for power supply cable, S-408-cct	2.50
1	J1	A	Connector, 8 pin, for amplifier, P-408-AB	1.50
1	R3,4	A	Control, var. resistor, 100,000 ohms w/switch	2.00
4	R15,16,18, 19	A	Control, var. resistor, PC type, state value req'd	.40
1	D3,4	A	Diode, 1N295, matched, set of two in amplifier	.75
14	D1 thru 14	PS	Diode, power supply rectifier, B339	1.25
1	D1	A	Diode, 1N459	.55
1	D2	A	Diode, B5G5	.55
8	---	Both	Feet, bakelite, for cabinets	.10
3	---	A	Knob, control, large, State Use	.80
2	---	A	Knob, control, small, State Use	.30
1	---	A	Lamp, on-off, 1050C3 Amber	.93
1	---	A	Lamp, SSB-CW, 1050C1 Red	.93

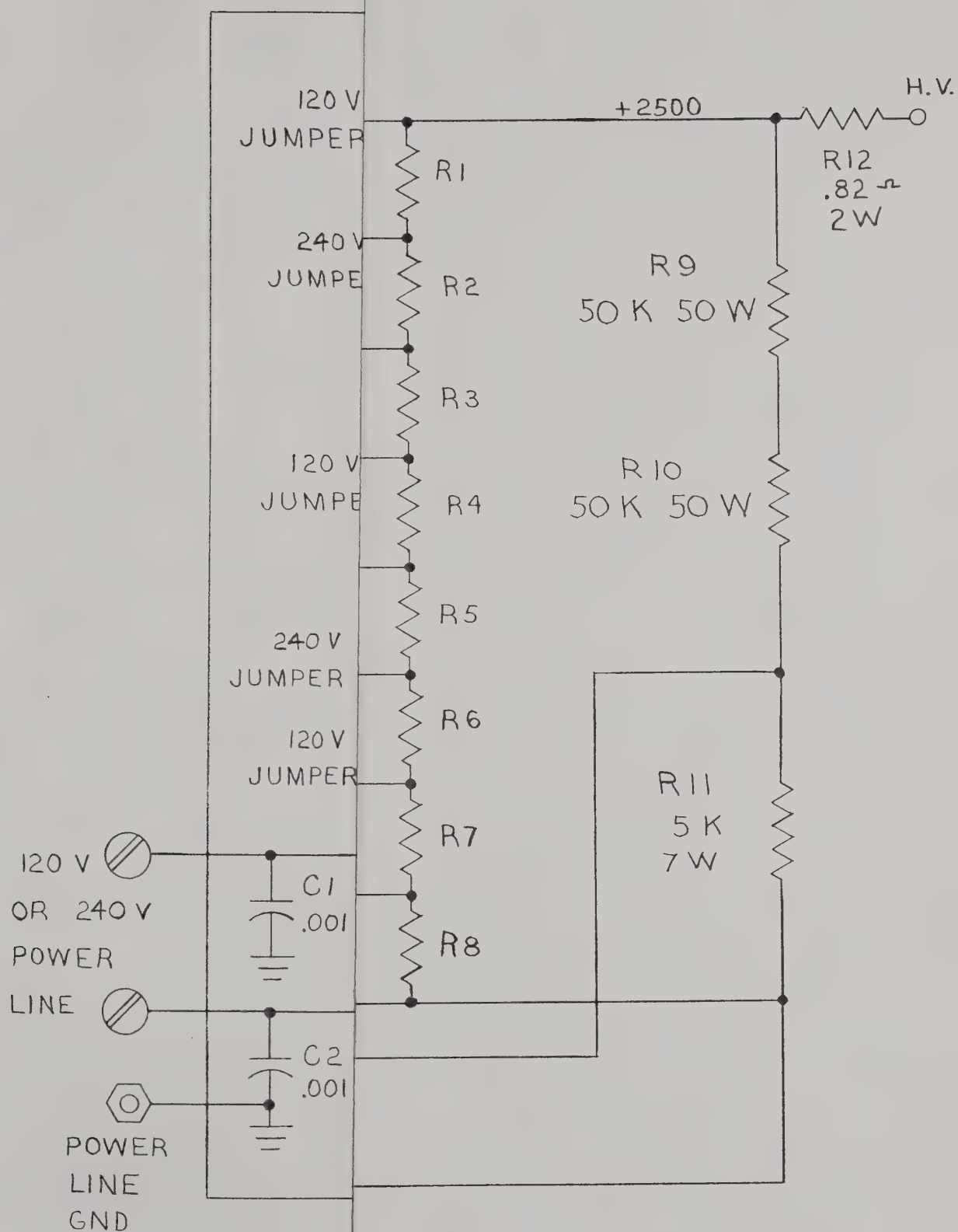
* When ordering, specify on which unit item is used.

L-4B LINEAR AMPLIFIER

SPARE PARTS LIST (continued)

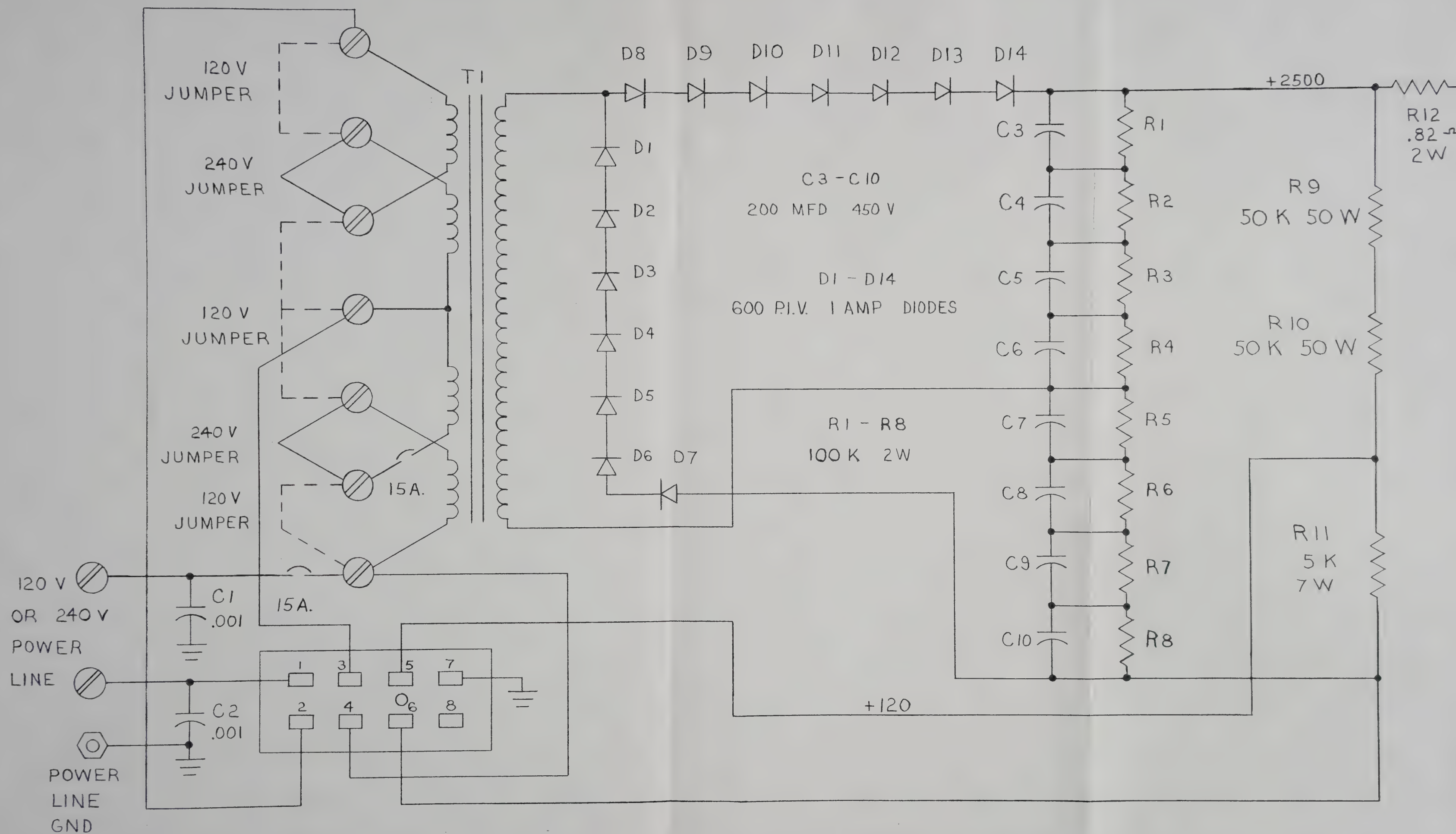
<u>QTY</u>	<u>SYMBOL</u>	<u>USED*</u> <u>ON</u>	<u>ITEM</u>	<u>PRICE</u> <u>EACH</u>
1	M1	A	Meter, plate, 1 amp.	\$16.00
1	M2	A	Meter, grid, 200 Wa.	16.00
1	---	A	Motor, blower (motor only)	8.00
1	---	A	Motor, Fan (blower)	1.30
1	---	A	Motor, housing	5.00
1	---	A	Panel, amplifier	7.00
2	---	A	Plate Cap, for 8163 or 3-500Z or 3-400Z (Specify)	.90
1	RY 1	A	Relay, antenna	6.75
2	R9, 10	PS	Resistor, 50,000 ohms, 50 W	1.50
1	R 11	PS	Resistor, 5,000 ohms, 7 W	1.05
-	-	PS	Resistor, 2 W 10% (Specify)	.25
2	---	A	Switch, on-off or SSB-CW	3.00
1	S3	A	Switch, meter selector	1.30
1	S2	A	Switch, band selector, ceramic	12.50
1	S1	A	Switch, input selector	3.75
1	---	PS	Transformer, plate	42.50
1	T1	A	Transformer, filament	13.95
2	---	A	Tube, 3-500Z	34.00
Accessory Items:				5.00
1 - Cable, AC-3/L-4B				
1 - Plug, Vox relay, 2 pin				.20

* When ordering, specify on which unit item is used.



POWER M
FROM SO SUPPLY

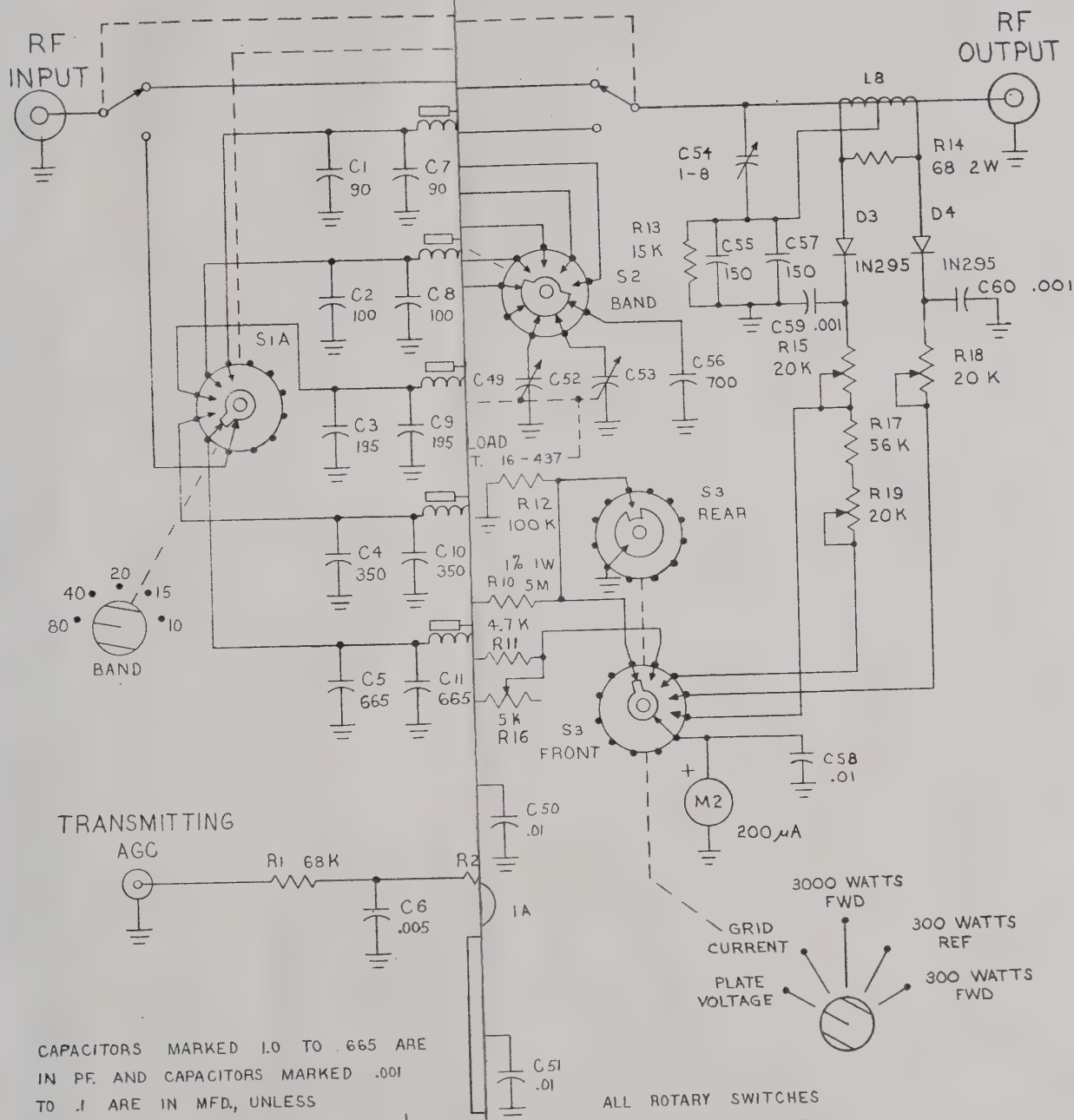
422688



POWER CONNECTOR SHOWN
FROM SOLDER CONNECTION END

SCHEMATIC DIAGRAM
MODEL L-4 PS POWER SUPPLY

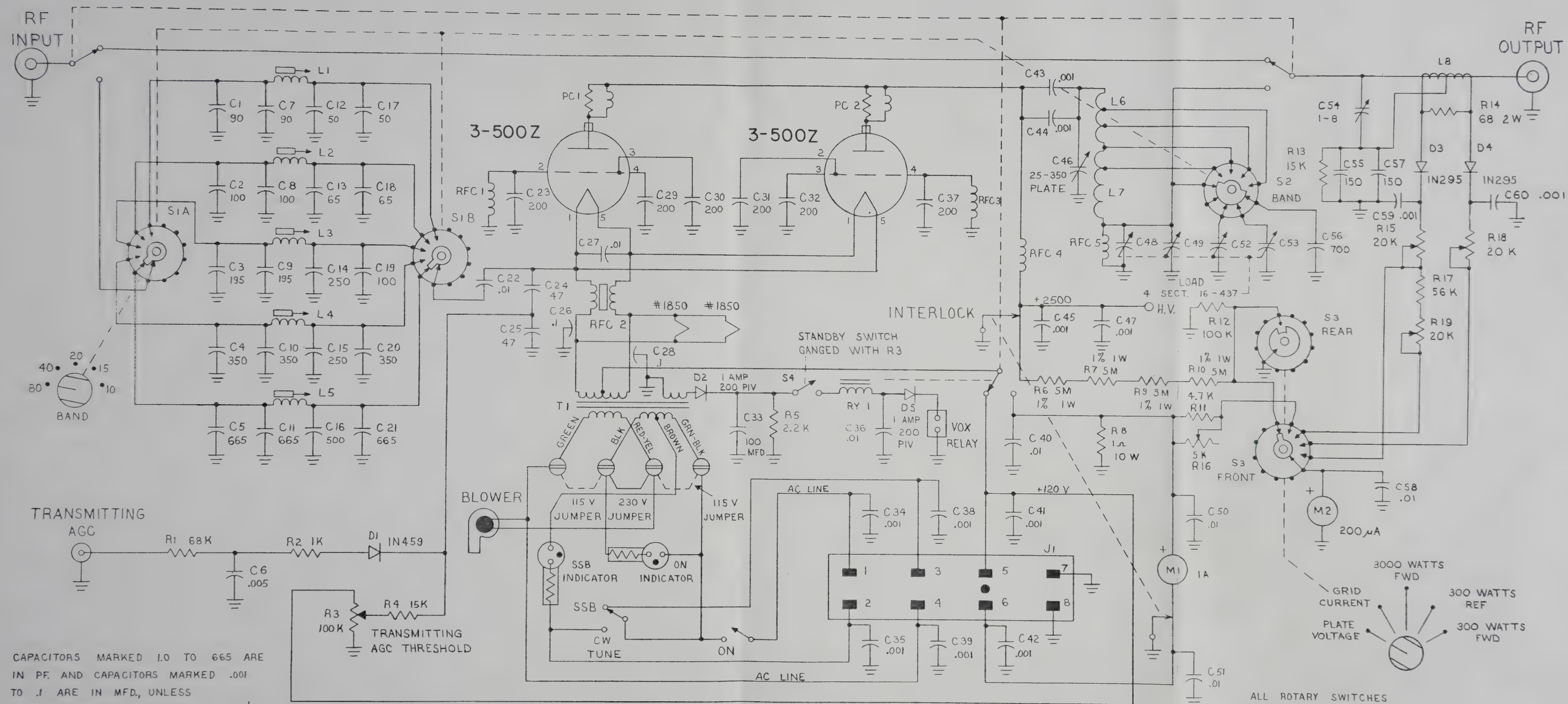
42268801



CAPACITORS MARKED 1.0 TO .665 ARE
IN PF. AND CAPACITORS MARKED .001
TO .1 ARE IN MFD, UNLESS
OTHERWISE NOTED. RESISTORS ARE $\frac{1}{2}$
WATT 10% EXCEPT WHERE NOTED.
J1 SHOWN OUTSIDE VIEW.
HIGHEST RESISTOR R19
HIGHEST CAPACITOR C60

801691301

ALL ROTARY SWITCHES
ARE SHOWN LOOKING
INTO SHAFT AND IN
FULLY CCW POSITION.



CAPACITORS MARKED 1.0 TO 665 ARE IN PF. AND CAPACITORS MARKED .001 TO 1 ARE IN MFD, UNLESS OTHERWISE NOTED. RESISTORS ARE $\frac{1}{2}$ WATT 10% EXCEPT WHERE NOTED. J1 SHOWN OUTSIDE VIEW. HIGHEST RESISTOR R19 HIGHEST CAPACITOR C60

801691301

SCHEMATIC DIAGRAM MODEL L-4B LINEAR AMPLIFIER

ALL ROTARY SWITCHES ARE SHOWN LOOKING INTO SHAFT AND IN FULLY CCW POSITION.

	Plate	Load
40m	bottom of 40	2.6

Amateur Radio 160 Meters U.S. Band Layout

Band Limits

Band Plan

NIGHT TIME BAND
LSB Voice

Personal Additions

G A E



— 2.000



1.999- 2.000 Beacons
1.995- 2.000 Experimental

— 1.975

— 1.950

— 1.925

— 1.900

— 1.910 QRP SSB Calling

— 1.890 SSTV

— 1.875

— 1.850

— 1.855 ARRL Voice
— 1.840- .850 DX Data,
Phone, wide modes
— 1.838.150 DX PSK
— 1.830- .840 DX CW, RTTY,
narrow modes
— 1.825 1.800- .830 CW, RTTY,
narrow modes
— 1.8175 ARRL Code
— 1.812.150 PSK
— 1.810 QRP CW Calling
— 1.800- .810 Digital Modes

— 1.800



CW, Phone, Image

CW, RTTY/Data

160

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hfband-5.cdr 1.05

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Amateur Radio

80 Meters

NIGHT AND LOCAL DAY

U.S. Band Layout

Band Limits

Band Plan *LSB Voice*

Personal Additions

N G A E

— 4.000

— 3.99 ARRL Voice

— 3.975

— 3.985 QRP Calling

— 3.950

— 3.925

— 3.900

— 3.875

— 3.885 AM Calling

— 3.850

— 3.845 SSTV

— 3.825

— 3.800

■ 3.790- .800 DX Window

— 3.775

— 3.750

— 3.725

— 3.700

— 3.710 QRP N/TCalling

— 3.675

— 3.650

— 3.625

3.625 ARRL RTTY

3.620- .635 Packet

3.590 DX RTTY

— 3.600

3.5815 ARRL Code

3.580.150 PSK

— 3.575

3.580- .620 RTTY

— 3.550

— 3.560 QRP Calling

— 3.525

— 3.500

■ 3.500- .510 DX Window

CW only

80



CW, Phone, Image

CW, RTTY/Data

CW

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Amateur Radio

60 Meters

U.S. Band Layout

USB Phone

Frequency

.....Band Plan.....

Personal Additions

G A E

— 5.425

Channel
Center

Tuning
Frequency

— 5.412.5

— 5.405 — 5.403.5 Tuning

— 5.400

— 5.387.5

— 5.375

— 5.373 — 5.371.5 Tuning

— 5.368 — 5.366.5 Tuning

— 5.362.5

— 5.350

— 5.348 — 5.346.5 Tuning

— 5.337.5

— 5.332 — 5.330.5 Tuning

— 5.325

60

Phone USB only
5 Shared Channels only,
tune 1.5kHz lower than center frequency

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Amateur Radio

40 Meters

U.S. Band Layout

Band Limits

Band Plan

LSB Phone

Personal Additions

N G A E



— 7.300

— 7.290 ARRL Voice
— 7.290 AM Calling
— 7.285 QRP Calling

— 7.275

— 7.250

— 7.225

— 7.200

— 7.175

— 7.171 SSTV

— 7.150

— 7.125

— 7.110 QRP N/T Calling
7.100-.105 Packet
— 7.100
— 7.095 ARRL RTTY
7.080.150 PSK
— 7.080-.100 RTTY

— 7.100

— 7.075

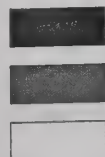
— 7.050

7.0475 ARRL Code
— 7.040 DX RTTY
— 7.040 QRP CW Calling
— 7.035.150 PSK
— 7.030 QRP DX CW Calling

— 7.025

— 7.000

40



CW, Phone, Image

CW, RTTY/Data

CW

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Amateur Radio

30 Meters

U.S. Band Layout

Band Limits

Band Plan

Personal Additions

G A E

— 10.150

— 10.145

— 10.140

— 10.135

— 10.130

— 10.125

— 10.120

— 10.115

— 10.110

— 10.105

— 10.100

10.140- .150 Packet

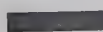
10.142-150 PSK

10.130- .140 RTTY

— 10.106 QRP Calling

~~NO PHONE~~ NO PHONE ON 30 M!

30



CW, RTTY/Data

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hfband-5.cdr r1.05

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Amateur Radio

20 Meters

WORLD WIDE DAY AFTER DAY

U.S. Band Layout

Band Limits

Band Plan

USB Phone

Personal Additions

G A E

— 14.350 ³⁴⁷

— 14.325

— 14.300

— 14.29 ARRL Voice

— 14.286 AM Calling

— 14.275

— 14.285 QRP Calling

— 14.250

— 14.225

— 14.230 SSTV

— 14.200

— 14.195 DX Calling

— 14.175

— 14.150

— 14.125

— 14.100

14.105- .112 Packet

14.100 Beacons

14.095- .0995 Packet

14.095 ARRL RTTY

— 14.075

14.070-150 PSK

14.070- .095 RTTY

— 14.050

— 14.060 QRP Calling

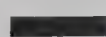
— 14.0475 ARRL Code

— 14.025

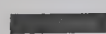
— 14.025 CW DX Calling

— 14.000

20



CW, Phone, Image



CW, RTTY/Data

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hfband-5.cdr r1.05

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Amateur Radio

17 Meters

U.S. Band Layout

WORLDWIDE - 24 HOURS A DAY

Band Limits

Band Plan

USB Phone

Personal Additions

G A E



— 18.168

— 18.160 ARRL Voice

— 18.150

— 18.125

— 18.110

18.105- .110 Packet

18.102.5 ARRL RTTY

18.100.150 PSK

— 18.100

18.100- .105 RTTY

— 18.097.5 ARRL Code

— 18.075

— 18.068

17



CW, Phone, Image

CW, RTTY/Data

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Amateur Radio

15 Meters

U.S. Band Layout

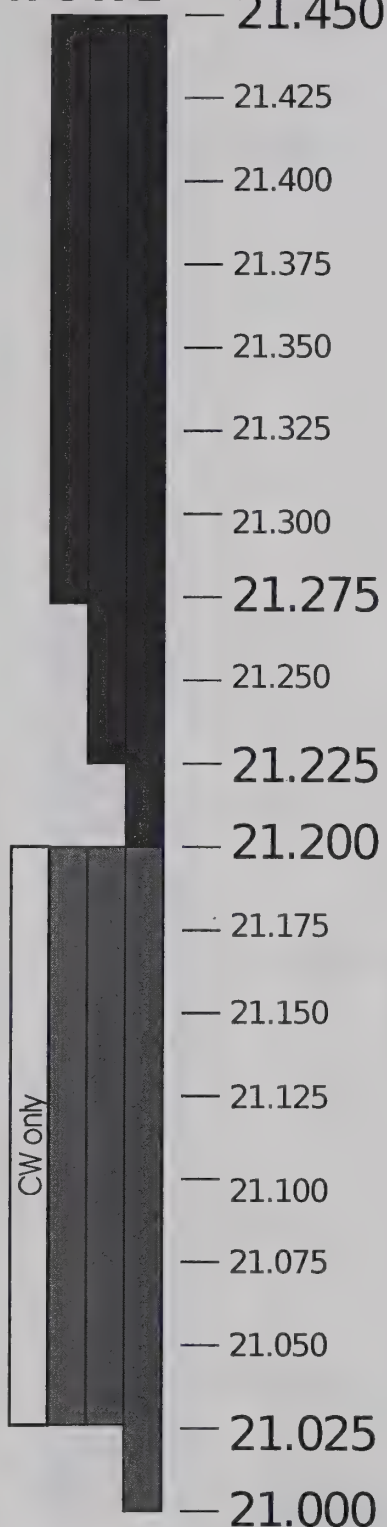
Band Limits

Band Plan

USB Phone

Personal Additions

N G A E



— 21.390 ARRL Voice
— 21.385 QRP Calling

— 21.340 SSTV

— 21.295 DX Calling

— 21.100- .110 Packet
— 21.095 ARRL RTTY
— 21.070- .150 PSK
— 21.070- .100 RTTY
— 21.067.5 ARRL Code
— 21.060 QRP Calling

— 21.025 CW DX Calling

15

CW, Phone, Image
 CW, RTTY/Data
 CW

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Amateur Radio

12 Meters

PRIMARILY A DAYTIME BAND

U.S. Band Layout

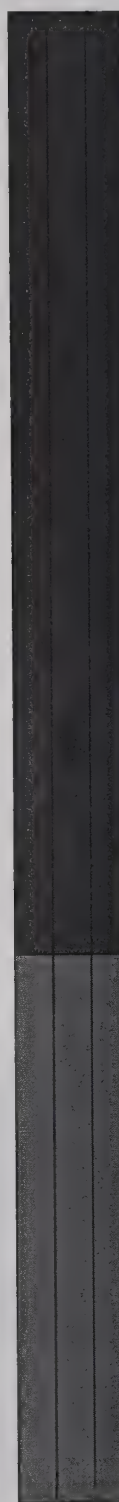
Band Limits

Band Plan

USB Phone

Personal Additions

G A E



— 24.990

— 24.980

— 24.970

— 24.960

— 24.950

— 24.940

— 24.930

— 24.920

— 24.910

— 24.900

— 24.890

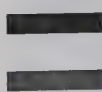


24.925- .930 Packet

24.920.150 PSK

24.920- .925 RTTY

12



CW, Phone, Image



CW, RTTY/Data

www.W1CGS.com

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hfband-5.cdr1.05

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Amateur Radio

10 Meters

U.S. Band Layout

Band Limits

Band Plan

U.S. Phone

Personal Additions

10

N G A E



— 29.700



29.620- .680 FM Rpt Out

— 29.600



29.600 FM Simplex

29.520- .580 FM Rpt In

— 29.500



— 29.400

29.300- .510 Sat-Down

— 29.300



— 29.200



— 29.100

29.000- .200 AM

— 29.000



— 28.900

— 28.800

— 28.700



28.680 SSTV

— 28.600



28.59 ARRL Voice

— 28.500



28.495 DX Calling

— 28.400



28.385 QRP Calling

— 28.300



28.200- .300 Beacons

— 28.200



— 28.100



28.120-150 PSK

28.095 ARRL RTTY

28.070- .150 RTTY

28.067.5 ARRL Code

28.060 QRP Calling

28.025 CW DX Calling

— 28.000



CW, Phone, Image

CW, SSB Phone

CW, RTTY/Data

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Code Question

QRG	Will you tell me my exact frequency (or that of ...)?	Your exact frequency (or that of ...) is ... kHz (or MHz).
QRI	How is the tone of my transmission?	The tone of your transmission is (1. Good; 2. Variable; 3. Bad)
QRK	What is the readability of my signals (or those of ...)?	The readability of your signals (or those of ...) is ... (1 to 5).
QRL	Are you busy?	I am busy. (or I am busy with ...) Please do not interfere.
QRM	Are you being interfered with?	I am being interfered with.
QRN	Are you troubled by static?	I am troubled by static.
QRO	Shall I increase power?	Increase power
QRP	Shall I decrease power?	Decrease power
QRQ	Shall I send faster?	Send faster (... wpm)
QRS	Shall I send slower?	Send slower (... wpm)
QRT	Shall I stop sending?	Stop sending.
QRU	Have you anything for me?	I have nothing for you.
QRV	Are you ready?	I am ready.
QRX	Will you call me again?	I will call you again at ... (hours) on ... kHz (or MHz)
QRZ	Who is calling me?	You are being called by ... on ... kHz (or MHz)
QSA	What is the strength of my signals (or those of ...)?	The strength of your signals (or those of ...) is ... (1 to 5).
QSB	Are my signals fading?	Your signals are fading.
QSD	Is my keying defective?	Your keying is defective.
QSK	Can you hear me between your signals?	I can hear you between my signals.
QSL	Can you acknowledge receipt?	I am acknowledging receipt.
QSM	Shall I repeat the last telegram (message) which I sent you, or some previous telegram (message)?	Repeat the last telegram (message) which you sent me (or telegram(s) (message(s)) numbers(s) ...).
QSN	Did you hear me (or ... (call sign)) on .. kHz (or MHz)?	I did hear you (or ... (call sign)) on ... kHz (or MHz).
QSO	Can you communicate with ... direct or by relay?	I can communicate with ... direct (or by relay through ...).

Answer or Statement

Q SX	Will you listen to ... (call sign(s) on ... kHz (or MHz))?	I am listening to ... (call sign(s) on ... kHz (or MHz))
Q SY	Shall I change to transmission on another frequency?	Change to transmission on another frequency (or on ... kHz (or MHz)).
Q TA	Shall I cancel telegram (message) No. ... as if it had not been sent?	Cancel telegram (message) No. ... as if it had not been sent.
Q TC	How many telegrams (messages) have you to send?	I have ... telegrams (messages) for you (or for ...).
Q TH	What is your position in latitude and longitude (or according to any other indication)?	My position is ... latitude...longitude
Q TR	What is the correct time?	The correct time is ... hours

US Amateur Radio Bands

US AMATEUR POWER LIMITS

All times, transmitter power should be kept down to that necessary to carry out the desired communications. Power is rated in watts PEP output. Except where noted, the maximum power output is 1500 Watts.

Effective Date

February 23, 2007

Published by:

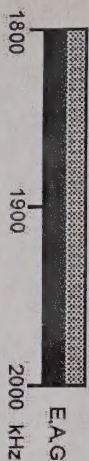
ARRL The National Association for
AMATEUR RADIO

www.arrl.org

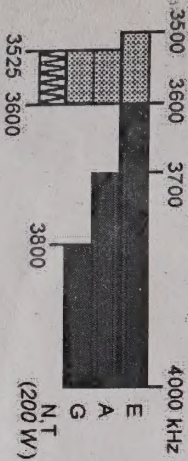
225 Main Street, Newington, CT USA 06111-1494

160 Meters (1.8 MHz)

Avoid interference to radiolocation operations from 1900 to 2000 kHz



80 Meters (3.5 MHz)

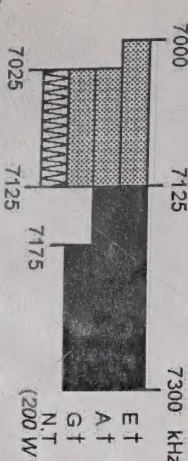


60 Meters (5.3 MHz) USB only



General, Advanced, and Amateur Extra licensees may use the following five channels on a secondary basis with a maximum effective radiated power of 50 W PEP relative to a half wave dipole. Only upper sideband suppressed carrier voice transmissions may be used. The frequencies are 5330.5, 5348.5, 5366.5, 5371.5 and 5403.5 kHz. The occupied bandwidth is limited to 2.8 kHz centered on 5332, 5348, 5368, 5373, and 5405 kHz respectively.

40 Meters (7 MHz)

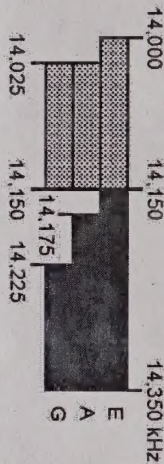


30 Meters (10.1 MHz)

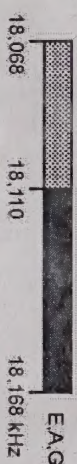
Avoid interference to fixed services outside the US.



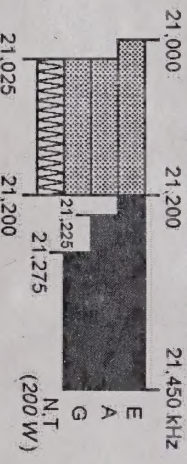
20 Meters (14 MHz)



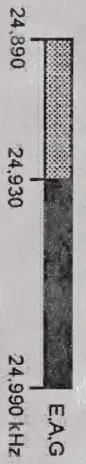
17 Meters (18 MHz)



15 Meters (21 MHz)



12 Meters (24 MHz)



10 Meters (28 MHz)



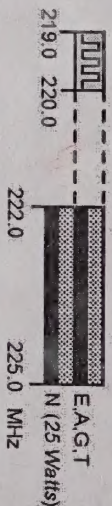
6 Meters (50 MHz)



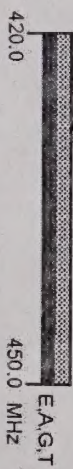
2 Meters (144 MHz)



1.25 Meters (222 MHz)



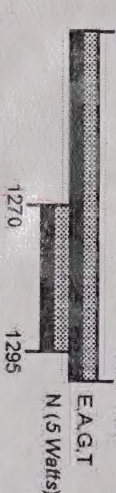
70 cm (420 MHz) *



33 cm (902 MHz) *



23 cm (1240 MHz) *



All licensees except Novices are authorized all modes on the following frequencies:

3000-10 MHz	10.0-10.5 GHz	122.25-123.0 GHz
2390-2450 MHz	24.0-24.25 GHz	134-141 GHz
3300-3600 MHz	47.0-47.2 GHz	241-250 GHz
6650-5925 MHz	76.0-81.0 GHz	All above 275 GHz

KEY

Note: CW operation is permitted throughout all amateur bands except 80 meters. MCW is authorized above 50.1 MHz, except for 21.8-22.0 MHz. Test transmissions are authorized above 51 MHz, except for 21.8-22.0 MHz.

- [Pattern] = RTTY and data
- [Pattern] = phone and image
- [Pattern] = CW only
- [Pattern] = SSB phone
- [Pattern] = USB phone only
- [Pattern] = Fixed digital message forwarding systems only

- E = Amateur Extra
- A = Advanced
- G = General
- T = Technician
- N = Novice

See ARRL Web at www.arrl.org for more detailed band plans.

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